

AMENDMENTS TO CLAIMS

The following listing of the claims replaces all prior claim versions and listings.

1. (Currently Amended) A memory access control device comprising:

a memory master to ~~make a request for access to memory;~~
a memory control unit to produce control signals of memories based on access information to be output from said memory master; and

a hit predicting unit to predict whether or not a next access to each bank in memory becomes access will be directed to a same page;

~~wherein said memory control unit, when a hit predicting unit predicts that "a page hit is found" a hit which means that "next access to said bank becomes access to a same page", said memory control unit terminates its a routine without closing a bank being presently accessed at a time of completion of present access operations and, when said hit predicting unit predicts that "a miss hit is found" which means that "next access to said bank becomes access to a different page" a miss, said memory control unit closes said bank being presently accessed at the time of completion of present access operations and terminates its the routine.~~

2. (Currently Amended) The memory access control device according to claim 1, wherein, ~~for each of said hit predicting unit stores results from a last "n" (n is a natural number) times of accesses to each bank in memory, said hit predicting unit stores as to whether a page hit or a miss has been found, or a miss hit has been found and said hit predicting unit predicts a hit, if a number of times of accesses by which a page hit is found out of the last "n" times of accesses is "m" or more ($m \leq n$: "m" and "n" are~~

natural numbers), that a page hit is found in next access to said bank, and said hit predicting unit ~~on the other hand predicts a miss~~, if said number of times of accesses is not "m" or more, ~~that a miss hit is found in next access to said bank~~.

3. (Currently Amended) The memory access control device according to claim 1, wherein, ~~for each of~~ said hit predicting unit stores results from last "j" ("j" is a natural number) times of accesses to each bank in memory, said hit predicting unit stores as to whether a page hit has been found or a miss hit has been found, and said hit predicting unit predicts a hit; when a page hit has been found in all of the last "j" times of accesses, ~~that a page hit is found in next access to said bank, and on the other hand~~ said hit predicting unit predicts a miss; if no page hit has been found at least one time in all of the last "j" times of accesses, ~~that a miss hit is found in next access to said bank~~.

4. (Currently Amended) The memory access control device according to claim 1, wherein, ~~for each of~~ said hit predicting unit stores results from last "k" ("k" is a natural number) times of accesses to each bank in memory, said hit predicting unit stores as to whether a page hit has been found or a miss hit has been found, and said hit predicting unit predicts a miss; if a miss hit has been found in all of the last "k" times of accesses, ~~that a miss hit is found in next access to said bank, and~~ said hit predicting unit on the other hand predicts a hit; if no miss hit has been found at least one time in all of the last "k" times of accesses, ~~that a miss hit is found in next access to said bank~~.

5. (Currently Amended) The memory access control device according to claim 1, wherein, ~~for each of a~~ said hit predicting unit stores results from last "n" ("n" is a natural number) times of accesses to each bank in memory, said hit predicting unit stores as to whether a page hit has been found or a miss hit has been found, and said hit predicting

unit predicts a miss; when a miss hit has been always found in all of the last "k" times of accesses ($k \leq n$: "k" and "n" ~~each are~~ is a natural number) out of the last "n" times of accesses, that a miss hit is found in next access to said bank and said hit predicting unit predicts a hit; when ~~no miss~~ a hit has been found at least one time in all of the last "k" times of accesses out of the last "n" times of accesses, and if a page hit has been always found in all of the last "j" times of accesses ($j \leq n$: "j" and "n" ~~each are~~ is a natural number) out of the last "n" times of accesses, that a page hit is found in next access to said bank and said hit predicting unit predicts a hit; when a miss hit has been found at least one time in all of the last "j" times of accesses out of the last "n" times of accesses, and if a number of times of accesses by which a page hit has been found out of the last "n" times of accesses is "m" times or more ($m \leq n$: "m" and "n" ~~each are~~ is a natural number), that a page hit is found in next access to said bank and said hit predicting unit predicts a miss; when a number of times of accesses by which a page hit has been found out of the last "n" times of accesses is not "m" times or more, ~~that a miss hit is found in~~ next access to said bank.

6. (Currently Amended) The memory access control device according to claim 1, wherein after a bank and a page to be accessed next have been determined, said memory master informs said memory control unit of information about said bank and said page to be accessed and wherein said memory control unit, if said bank to be accessed next by said memory master is the bank same as that being presently accessed and said page to be accessed by said memory master is same as that the page being presently accessed, said memory control unit terminates its the routine, regardless of ~~a the~~ prediction result from said hit predicting unit, without closing said bank being presently accessed at the time of

completion of present access operations and, if said bank to be accessed next by said memory master is ~~same as that~~the bank being presently accessed and said page to be accessed by said memory master is different from ~~that~~the page being presently accessed, said memory control unit closes said bank being presently accessed at the time of completion of present access operations, regardless of ~~a~~the prediction result from said hit predicting unit, and the memory control unit terminates ~~its~~the routine.

7. (Currently Amended) The memory access control device according to claim 2, wherein after a bank and a page to be accessed next have been determined, said memory master informs said memory control unit of information about said bank and said page to be accessed and wherein said memory control unit, if said bank to be accessed next by said memory master is ~~same as that~~the bank being presently accessed and said page to be accessed by said memory master is ~~same as that~~the page being presently accessed, said memory control unit terminates ~~its~~the routine, regardless of ~~a~~the prediction result from said hit predicting unit, without closing said bank being presently accessed at the time of completion of present access operations and, if said bank to be accessed next by said memory master is ~~same as that~~the bank being presently accessed and said page to be accessed by said memory master is different from ~~that~~the page being presently accessed, said memory control unit closes said bank being presently accessed at the time of completion of present access operations, regardless of ~~a~~the prediction result from said hit predicting unit, and said memory control unit terminates ~~its~~the routine.

8. (Currently Amended) The memory access control device according to claim 3, wherein after a bank and a page to be accessed next have been determined, said memory master informs said memory control unit of information about said bank and said page to

be accessed and wherein said memory control unit, if said bank to be accessed next by said memory master is ~~same as that~~the bank being presently accessed and said page to be accessed by said memory master is ~~same as that~~the page being presently accessed, said memory control unit terminates ~~its~~the routine, regardless of a ~~the~~ prediction result from said hit predicting unit, without closing said bank being presently accessed at the time of completion of present access operations and, if said bank to be accessed next by said memory master is ~~same as that~~the bank being presently accessed and said page to be accessed by said memory master is different from ~~that~~the page being presently accessed, said memory control unit closes said bank being presently accessed at the time of completion of present access operations, regardless of a ~~the~~ prediction result from said hit predicting unit, and said memory control unit terminates ~~its~~the routine.

9. (Currently Amended) The memory access control device according to claim 4, wherein after a bank and a page to be accessed next have been determined, said memory master informs said memory control unit of information about said bank and said page to be accessed and wherein said memory control unit, if said bank to be accessed next by said memory master is ~~same as that~~the bank being presently accessed and said page to be accessed by said memory master is ~~same as that~~the page being presently accessed, said memory control unit terminates ~~its~~the routine, regardless of a ~~the~~ prediction result from said hit predicting unit, without closing said bank being presently accessed at the time of completion of present access operations and, if said bank to be accessed next by said memory master is ~~same as that~~the bank being presently accessed and said page to be accessed by said memory master is different from ~~that~~the page being presently accessed, said memory control unit closes said bank being presently accessed at the time of

completion of present access operations, regardless of ~~a the~~ prediction result from said hit predicting unit, and said memory control unit terminates ~~its the~~ routine.

10. (Currently Amended) The memory access control device according to claim 5, wherein after a bank and a page to be accessed next have been determined, said memory master informs said memory control unit of information about said bank and said page to be accessed and wherein said memory control unit, if said bank to be accessed next by said memory master is ~~same as that~~ the bank being presently accessed and said page to be accessed by said memory master is ~~same as that~~ the page being presently accessed, said memory control unit terminates ~~its the~~ routine, regardless of ~~a the~~ prediction result from said hit predicting unit, without closing said bank being presently accessed at the time of completion of present access operations and, if said bank to be accessed next by said memory master is ~~same as that~~ the bank being presently accessed and said page to be accessed by said memory master is different from ~~that the~~ the page being presently accessed, said memory control unit closes said bank being presently accessed at the time of completion of present access operations, regardless of ~~a the~~ prediction result from said hit predicting unit, and said memory control unit terminates ~~its the~~ routine.

11. (Currently Amended) A memory access control device comprising:

two or more memory masters to ~~make a request for~~ access to memory; an arbiter unit to arbitrate memory access requests fed from said memory masters and to select access information fed from any one of said memory masters;

a memory control unit to produce a control signal of memory based on access information output from said arbiter unit; and

a hit predicting unit to predict whether or not a next access to each bank in

memory becomes access will be directed to a same page;

wherein ~~said memory control unit~~, when said hit predicting unit predicts that "a page hit is found" which means that "next access to said bank is access to a same page" a hit, said memory control unit terminates its a routine without closing said bank being presently accessed at a time of completion of present access operations, and when said hit predicting unit predicts that "a miss hit is found" which means that "next access to said bank is access to a different page" a miss, said memory control unit closes said bank being presently accessed at the time of present access operations and terminates its the routine.

12. (Currently Amended) The memory access control unit according to claim 11, wherein, for each of said hit predicting unit stores results from a last "n" ("n" is a natural number) times of accesses to each bank in memory, said hit predicting unit stores as to whether a page hit has been found or a miss hit has been found and said hit predicting unit predicts a hit, if a number of times of accesses by which a page hit is found out of the last "n" times of accesses is "m" or more ($m \leq n$: "m" and "n" each are is a natural number), that a page hit is found in next access to said bank and said hit predicting unit predicts a miss, if said number of times of accesses is not "m" or more, that a miss hit is found in next access to said bank.

13. (Currently Amended) The memory access control device according to claim 11, wherein, for each of said hit predicting unit stores results from a last "j" ("j" is a natural number) times of accesses to each bank in memory, said hit predicting unit stores as to whether a page hit has been found or a miss hit has been found, and said hit predicting unit predicts a hit, when a page hit has been found in all of the last "j" times of accesses, that a page hit is found in next access to said bank and said hit predicting unit

~~predicts a miss, if no page-hit has been found in all of the last "j" times of accesses, that a miss hit is found in next access to said bank.~~

14. (Currently Amended) The memory access control device according to claim 11, wherein, ~~for each of said hit predicting unit stores results from~~ last "k" ("k" is a natural number) times of accesses to each bank in memory, said hit predicting unit stores as to whether a page-hit has been found or a miss hit has been found, and said hit predicting unit predicts a miss, if a miss hit has been found in all of the last "k" times of accesses, that a miss hit is found in next access to said bank and said hit predicting unit predicts a hit, if no miss hit has been found in all of the last "k" times of accesses, that a page hit is found in next access to said bank.

15. (Currently Amended) The memory access control device according to claim 11, wherein, ~~for each of a said hit predicting unit stores results from~~ last "n" ("n" is a natural number) times of accesses to each bank in memory, said hit predicting unit stores as to whether a page-hit has been found or a miss hit has been found, and said hit predicting unit predicts a miss, when a miss hit has been found in all of the last "k" ($k \leq n$: "k" and "n" each are is a natural number) times of accesses out of the last "n" times of accesses, that a miss hit is found in next access to said bank and said hit predicting unit predicts a hit, when no miss hit has been found at least one time in all of the last "k" times of accesses out of the last "n" times of accesses, and if a page-hit is found in all of the last "j" times of accesses ($j \leq n$: "j" and "n" each are is a natural number) out of the last "n" times of accesses, that a page hit is found in next access to said bank and said hit predicting unit predicts a hit, when a miss hit has been found at least one time in all of the last "j" times of accesses out of the last "n" times of accesses, and if a number of times of

accesses by which a page-hit has been found out of the last "n" times of accesses is ~~is~~ "m" times or more ($m \leq n$: "m" and "n" each ~~are~~ is a natural number), ~~that a page-hit is found in next access to said bank and~~ said hit prediction unit predicts a miss, when a number of times of accesses by which a page-hit has been found out of the last "n" times of accesses is not "m" times or more, ~~that a miss-hit is found in next access to said bank.~~

16. (Currently Amended) The memory access control device according to claim 11, wherein after a bank and a page to be accessed next have been determined, each memory master informs said arbiter unit and said memory control unit of information about said bank and said page to be accessed next and wherein said memory control unit, if there exists said memory master which gets the next access to a same~~the~~ bank as ~~that being~~ presently accessed and to ~~a same~~the page as ~~that being~~ presently accessed, said memory control unit terminates its~~the~~ routine without closing said bank being presently accessed at the time of completion of present access operations, regardless of ~~a~~the prediction result fed from said hit predicting unit, ~~and terminates its routine and~~, if there exists said memory master which gets the next access to a same~~the~~ bank as ~~that being~~ presently accessed and to a page ~~being different from that~~the page being presently accessed, said memory control unit closes said bank being presently accessed at the time of completion of present access operations, regardless of ~~a~~the prediction result fed from ~~a~~the hit predicting unit, and said memory control unit terminates its~~the~~ routine ~~and said arbiter unit, and~~ if there exists said memory master which gets the next access to a same~~the~~ bank being presently accessed and ~~a same~~the page as ~~those being~~ presently accessed, said arbiter unit selects said memory master with priority.

17. (Currently Amended) The memory access control device according to claim

12, wherein after a bank and a page to be accessed next have been determined, each memory master informs said arbiter unit and said memory control unit of information about said bank and said page to be accessed next and wherein said memory control unit, if there exists said memory master which gets the next access to a ~~same~~the bank as that being presently accessed and to a ~~same~~the page as that being presently accessed, said memory control unit terminates ~~its~~ the routine without closing said bank being presently accessed at the time of completion of present access operations, regardless of a ~~the~~ prediction result fed from said hit predicting unit, ~~and terminates its routine and~~, if there exists said memory master which gets the next access to a ~~same~~the bank as that being presently accessed and to a page ~~being different from that~~ the page being presently accessed, said memory control unit closes said bank being presently accessed at the time of completion of present access operations, regardless of a ~~the~~ prediction result fed from a ~~the~~ hit predicting unit, and said memory control unit terminates ~~its~~ the routine ~~and said arbiter unit, and~~ if there exists said memory master which gets the next access to a ~~same~~the bank being presently accessed and a ~~same~~the page as those being presently accessed, said arbiter unit selects said memory master with priority.

18. (Currently Amended) The memory access control device according to claim 13, wherein after a bank and a page to be accessed next have been determined, each memory master informs said arbiter unit and said memory control unit of information about said bank and said page to be accessed next and wherein said memory control unit, if there exists said memory master which gets the next access to a ~~same~~the bank as that being presently accessed and to a ~~same~~the page as that being presently accessed, said memory control unit terminates ~~its~~ the routine without closing said bank being presently

accessed at the time of completion of present access operations, regardless of a the prediction result fed from said hit predicting unit, and ~~terminates its routine and~~, if there exists said memory master which gets the next access to a ~~same~~the bank as ~~that~~ being presently accessed and to a page ~~being different from that~~ the page being presently accessed, said memory control unit closes said bank being presently accessed at the time of completion of present access operations, regardless of a the prediction result fed from a the hit predicting unit, and said memory control unit ~~terminates its~~ the routine and ~~said arbiter unit~~, and if there exists said memory master which gets the next access to a ~~same~~the bank being presently accessed and a ~~same~~the page as ~~those~~ being presently accessed, said arbiter unit selects said memory master with priority.

19. (Currently Amended) The memory access control device according to claim 14, wherein after a bank and a page to be accessed next have been determined, each memory master informs said arbiter unit and said memory control unit of information about said bank and said page to be accessed next and wherein said memory control unit, if there exists said memory master which gets the next access to a ~~same~~the bank as ~~that~~ being presently accessed and to a ~~same~~ the page as ~~that~~ being presently accessed, said memory control unit ~~terminates its~~ the routine without closing said bank being presently accessed at the time of completion of present access operations, regardless of a the prediction result fed from said hit predicting unit, and ~~terminates its routine and~~, if there exists said memory master which gets the next access to a ~~same~~the bank as ~~that~~ being presently accessed and to a page ~~being different from that~~ the page being presently accessed, said memory control unit closes said bank being presently accessed at the time of completion of present access operations, regardless of a the prediction result fed from

~~a the hit predicting unit, and said memory control unit terminates its the routine and said arbiter unit, and if there exists said memory master which gets the next access to a same the bank being presently accessed and a same the page as those being presently accessed, said arbiter unit selects said memory master with priority.~~

20. (Currently Amended) The memory access control device according to claim 15, wherein after a bank and a page to be accessed next have been determined, each memory master informs said arbiter unit and said memory control unit of information about said bank and said page to be accessed next and wherein said memory control unit, if there exists said memory master which gets the next access to a same the bank as that being presently accessed and to a same the page as that being presently accessed, said memory control unit terminates its the routine without closing said bank being presently accessed at the time of completion of present access operations, regardless of a the prediction result fed from said hit predicting unit, and terminates its routine and, if there exists said memory master which gets the next access to a same the bank as that being presently accessed and to a page being different from that the page being presently accessed, said memory control unit closes said bank being presently accessed at the time of completion of present access operations, regardless of a the prediction result fed from a the hit predicting unit, and said memory control unit terminates its the routine and said arbiter unit, and if there exists said memory master which gets the next access to a same the bank being presently accessed and a same the page as those being presently accessed, said arbiter unit selects said memory master with priority.